INSTRUCTION MANUAL
FOR
MODEL TN 33
TEST HYBRID

northern telecom

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FOR
MODEL TN 33
TEST HYBRID

NORTHEAST ELECTRONICS CORPORATION
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INTRODUCTION

This publication contains the Description and Specifications, Operating Instructions, Circuit Description, Maintenance Instructions and Electronic Parts List for the Model TN 33 Test Hybrid, manufactured by Northeast Electronics Corporation, Concord, New Hampshire.

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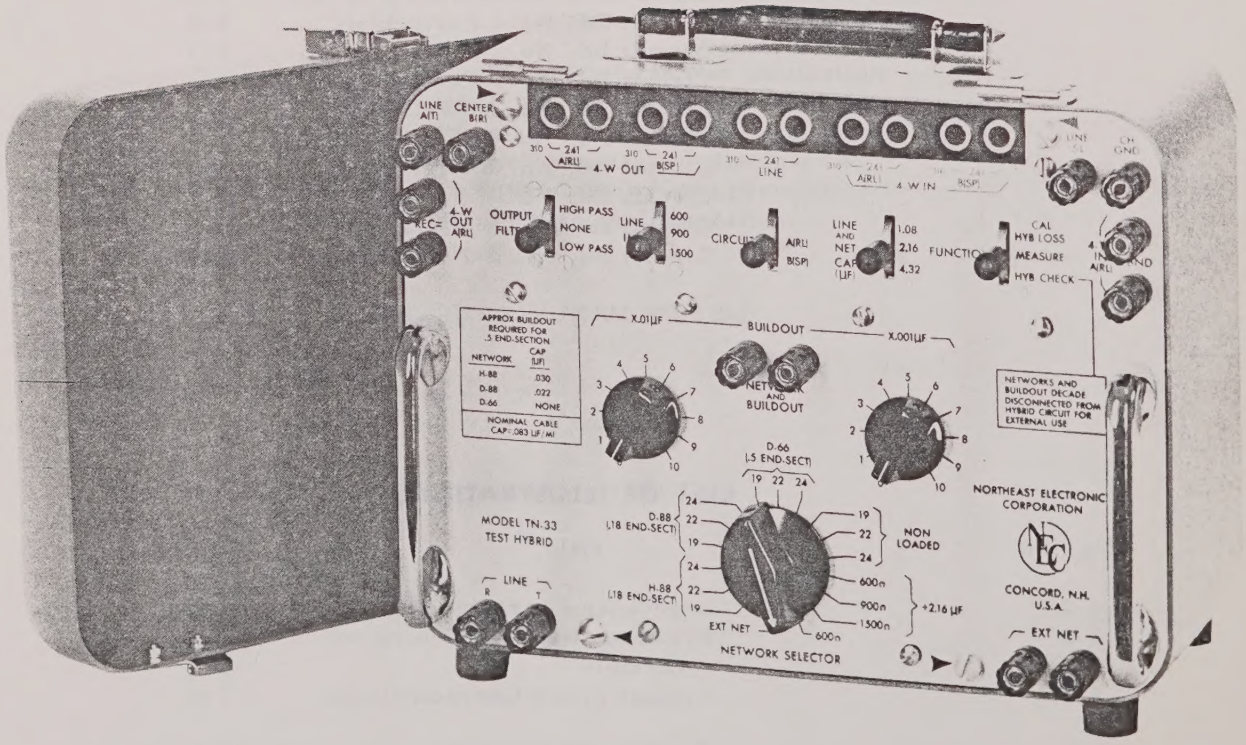


SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 GENERAL

1.2 The Model TN 33 is a portable test hybrid useful in the performance of a variety of balance measurements. The unit contains two NEC TN 44 special transformers, precision balance network, network-buildout decades, a low-pass filter and a high-pass filter. The various circuit arrangements are selected by means of keys and rotary switches. All important points of the circuit are accessible at jacks and terminals.

1.3 Three modes of operation are selected by the FUNCTION switch.

a. MEASURE: This switch position is used in measuring the balance of a circuit under test. In this position, other switches permit the connection of one of the internal networks, an external network and/or the buildout decades to the hybrid "network" branch.

b. HYBRID CHECK: In this switch position, matched 600 ohm resistors, are substituted for the network and the external line termination to check the basic input-to-output (transhybrid) balance of the test set.

c. CALIBRATE HYBRID LOSS: In this switch position, a short circuit is applied across the line branch while retaining the selected network; this permits measurement of the hybrid insertion loss.

1.4 By means of the LINE IMP key switch, matching to lines having a characteristic impedance of 600, 900, or 1500 ohms is provided. A 600 ohm nominal impedance is maintained at the 4W IN and 4W OUT terminals for each of the three switch positions.

1.5 Precision networks covering the most common H-88*, D-88* and D-66* and non-loaded facilities, 600, 900 and 1500 ohms compromise terminations, a 600 ohm resistor, and a set of terminals to connect an external network are selected by a rotary NETWORK SELECTOR switch. Setting the FUNCTION switch to HYB CHECK disconnects the network circuits from the hybrid transformers. In this position, the NETWORK terminals, which are connected to the NETWORK SELECTOR switch arms, permit use of the networks in external circuits.

1.6 Two buildout capacitance decades, covering the range from 0.0 to 0.11μF are connected in parallel with the networks. These also permit using the TN 33 Hybrid set as a direct reading capacitance bridge. Additional capacitance may be connected to the NETWORK BUILDOUT terminals as required.

1.7 A choice of three different capacitors in series with both the line and network windings of the hybrid transformers is provided by the LINE and NET CAP key switch. The capacitors in the line windings are accessible at the LINE CENTER terminals, A (T) and B (R). Matched 1.08, 2.16 and 4.32μF capacitors can be selected to simulate the capacitors encountered in most offices.

1.8 A low-pass or a high-pass filter may be inserted in the hybrid output circuit with the FILTER key switch.

1.9 Two sets of 4-wire input and output jacks, designated A and B, are controlled by the CIRCUIT key switch. This switch permits the operator to transfer between different measurements, such as from loss (A) to singing point measurements (B), using the NEC Model TTS 12A Singing Point Test Set.

1.10 The set is entirely contained within an 8" x 11" x 7" carrying case, includes a handle and removable cover and weighs 15½ lb. A front panel view is shown in fig. 2-1.

1.11 SPECIFICATIONS

1.12 TRANSHYBRID BALANCE: Inherent balance measured at the 4-wire input, for the following matched resistive line and network terminations, is better than:

60 dB; 200 - 6000 ohms, 200 - 4000 cps
65 dB; 200 - 2000 ohms, 500 - 2500 cps
50 dB; 200 - 6000 ohms, 200 - 10,000 cps

NOTE

The HYB CHECK Function permits checking 600 ohm balance up to 70 dB.

1.13 TRANSHYBRID LOSS. Insertion loss from 4-wire output: 7.0 ± 0.5 dB, 200 - 10,000 cps.

1.14 IMPEDANCES:

a. 4-wire input and output: Balanced 600 ohms, nominal, with 600, 900 or 1500 ohms line and network terminations selected by the LINE IMP key 75V dc blocked.

b. Line and Network: Balance 600, 900 or 1500 ohms, nominal, with 600 ohm 4-wire input and output terminations. 400V dc blocked by matched 1.08, 2.16 or 4.32μF capacitors. Impedance vs frequency characteristics are typical of sets equipped with WE 120P type coils. See fig. 1-1 for representative characteristics.

1.15 NETWORKS. Component tolerances are within ±1% for the following:

a. PRECISION NETWORKS (See fig. 1-2) Cable gauge & type: 19 cnb, 22 csa 24 dsm
Nominal cable capacity: 0.83μF per mi.

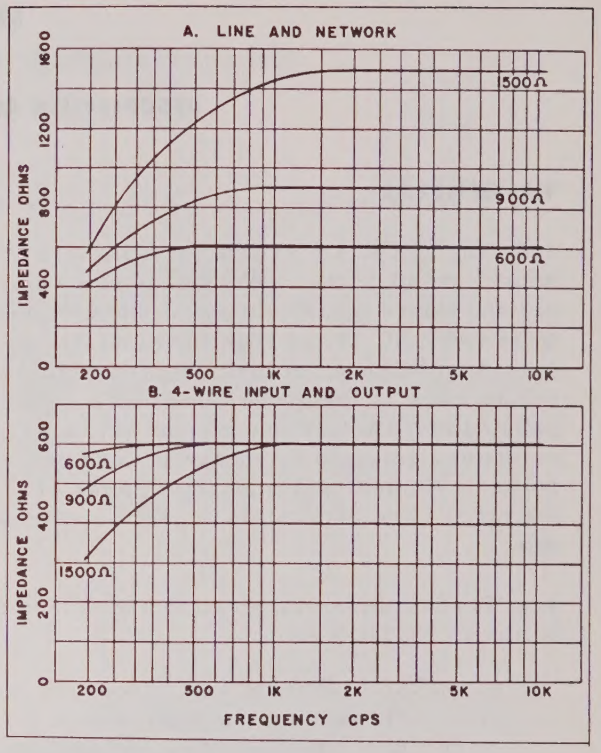


Fig. 1-1 Impedance Characteristics

Approx. basic end-section:
H-88* .18 (1100 ft)
D-88* .18 (800 ft)
D-66* .05 (2500 ft)

b. COMPROMISE NETWORKS: 600, 900 and 1500 ohms, each in series with 2.16 μF.

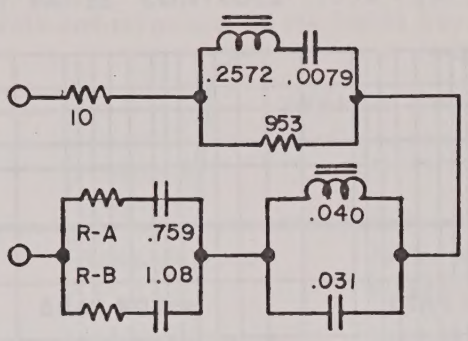
c. 600 Ohm

NETWORK BUILDOUT. Two section additive capacitance decade: 0 (open) to .11μF in .001μF steps; ±1% at any setting.

FILTERS. High pass*, Low pass*. See fig. 1-3 for typical response characteristics.

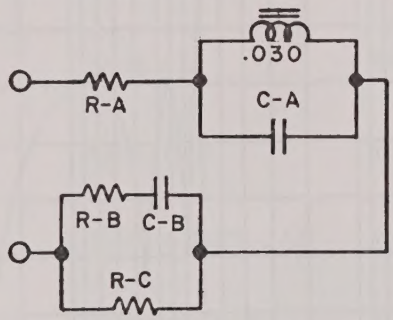
SIZE: 8" x 11" x 7", including cover.

WEIGHT: 15½ lb.



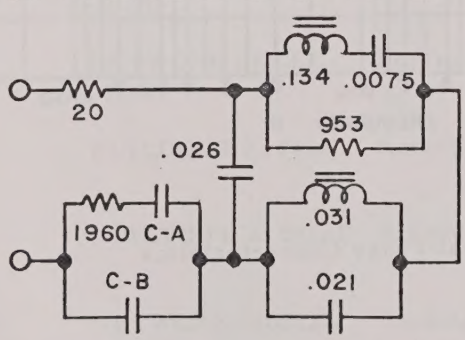
	19H-88	22H-88
R-A	—	86.6
R-B	200	1854

19, 22H-88



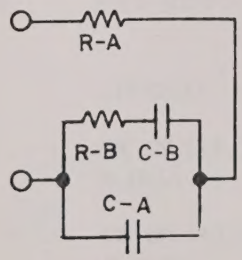
	24H-88	19D-88	22D-88	24D-88
R-A	980	1000	1030	1040
R-B	71.5	—	—	—
R-C	4107	1475	2130	3290
C-A	.043	.034	.034	.034
C-B	.66	1.97	1.14	.90

24H-88 and D-88



	19D-66	22D-66	24D-66
C-A	2.310	1.070	.715
C-B	1.686	.936	.585

D-66



	19 NL	22 NL	24 NL
R-A	155	201.4	251.4
R-B	628	944	1193.4
C-A	.40	.25	.20
C-B	.80	.80	.50

NON LOADED

Fig. 1-2 Precision Networks - Equivalent Circuits

Section 1
Figure 1-4

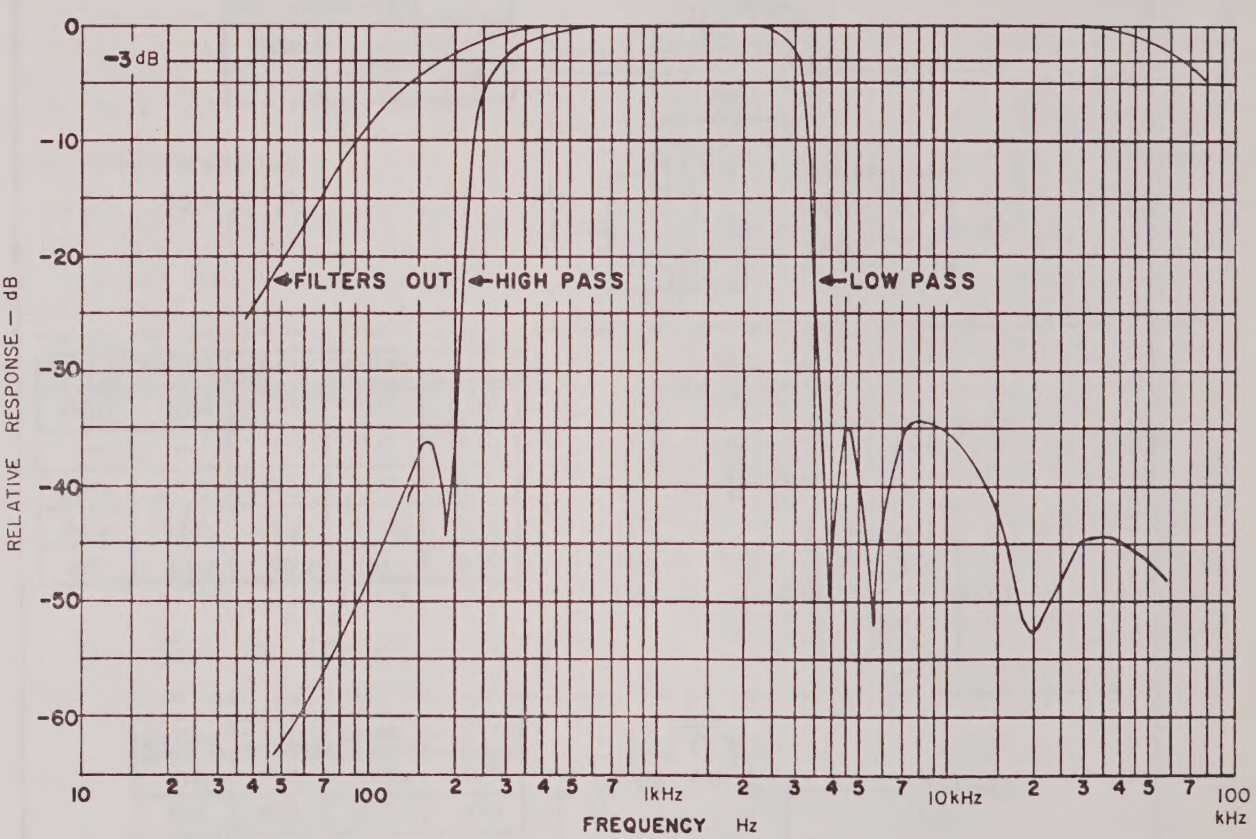


Fig. 1-3 Typical Filter Characteristics

SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS Table I and Figure 2-1 describe and locate all the front panel controls and terminals on the TN 33 Test Set.

TABLE I Front Panel Controls

Ref Desig.	Name of Control	Type of Control	Use or Purpose
J10 & J11	LINE 241/310	Jacks for 241/310 type plugs	For connection to line under test.
J8 & J9	LINE R & T	Binding Posts	Parallel connection to tip and ring of LINE jack.
J16	LINE SL	Binding Posts	Parallel connection to sleeves of LINE jacks.
S1	LINE IMP	Key switch	Selects required impedance on both input and output.
S7	LINE & NET CAP	Key switch	Selects internal Line and Network capacitance.
J23 & J24	LINE CENTER A (T) B (R)	Binding Posts	Provides signal access to line under test.
S4	NETWORK SELECTOR	Rotary switch	For selection of the required network.
S5	BUILDOUT X.01μF	Rotary switch	For selection of required buildout capacitance.
S6	BUILDOUT X.001μF	Rotary switch	For selection of required buildout capacitance.
J21 & J22	NETWORK BUILDOUT	Binding Posts	For connection to the network and buildout circuits.
J12 & J13	EXT NET	Binding Posts	To allow connection of an external network.
S8	CIRCUIT	Key switch	Selects either A or B circuit
J4 & J5	4W IN 241/310 A (RL)	Jacks for 241/310 type plugs	Input jacks for return loss measurement.
J6 & J7	4W IN 241/310 B (SP)	Jacks for 241/210 type plugs	Input jacks for singing point measurement.
J1 & J2	4W IN - SND A (RL)	Binding Posts	Input jacks for return loss measurement.

TABLE I Front Panel Controls (cont.)

Ref Desig.	Name of Control	Type of Control	Use or Purpose
J3	CH GND	Binding Posts	Chassis Ground
J17 & J18	4W OUT 241/310 A (RL)	Jacks for 241/310 type plugs	Output Jacks for return loss measurements.
J19 & J20	4W OUT 241/310 B (SP)	Jacks for 241/310 type plugs	Output jacks for singing point measurement.
J14 & J15	REC 4W OUT A (RL)	Binding Posts	Parallel connection to tip and ring of J17 and J18.
S2	OUTPUT FILTER	Key switch	Selects required output filter.
S3	FUNCTION	Key switch	Selects mode of operation.

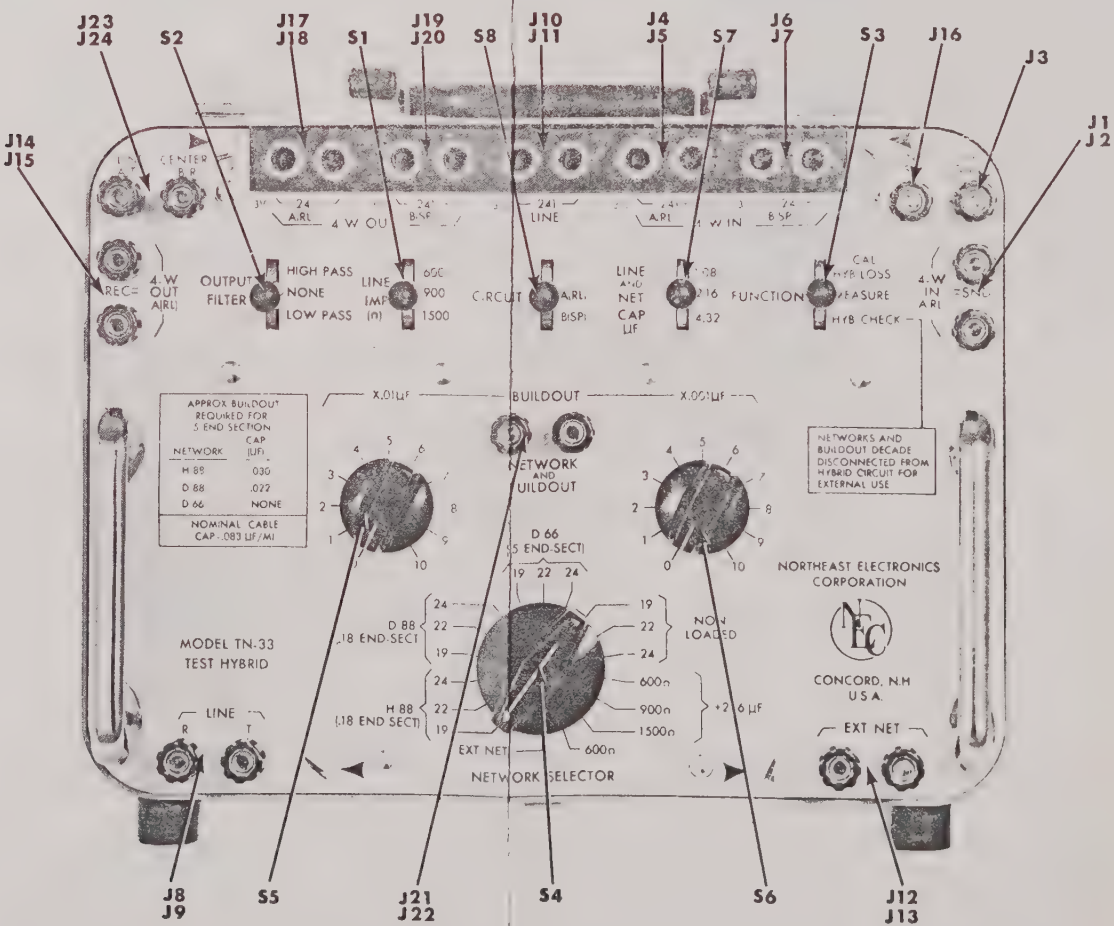


Fig. 2-1 Front Panel Controls

2.2 OPERATION

2.3 RETURN LOSS MEASUREMENTS

a. Connect line or circuit under test to the LINE terminals and associated test equipment to the appropriate terminals. Set the CIRCUIT switch for the 4W set used.

b. Set the LINE IMP, LINE & NET CAP, BUILDOUT, and NETWORK SELECTOR switches for circuit requirements.

c. Set FILTER switch to LOW PASS, NONE, or HIGH PASS, as required.

d. Perform measurements in accordance with specified test procedure.

2.4 SINGING POINT MEASUREMENT

a. Connect line or circuit under test to the LINE terminals, and an NEC 12A Singing Point Test Set, or equivalent to the A or B 4W IN and OUT terminals. Set CIRCUIT switch accordingly.

b. Perform measurements as above.

2.5 CAPACITANCE MEASUREMENTS

a. Connect an oscillator and a measuring set to the 4W IN and 4W OUT terminals respectively. Adjust for desired frequency at a convenient level, approximately 0 dBm.

b. Connect circuit under test to the LINE terminals.

c. Set NETWORK SELECTOR switch to EXT NET.

d. Adjust BUILDOUT decades for best null reading on measuring set. The sum of the two switches settings is the value of the unknown capacitance to the nearest .001μF. If the unknown value of capacitance is greater than .11μF, an external capacitor(s) of known value may be connected across the BUILDOUT terminals so that a null is obtained. The unknown capacitance is the sum of the decade settings and the value of the external capacitor(s).

2.6 NETWORK AND BUILDOUT ACCESS FOR EXTERNAL USE.

a. Set FUNCTION switch to HYB CHECK.

b. Set NETWORK SELECTOR switch to desired network.

c. Network and buildout decades are now accessible at the NETWORK and BUILDOUT terminals.

2.7 TRANSHYBRID BALANCE CHECK. The inherent type hybrid coil balance may be determined in the following manner:

a. Set FUNCTION switch to CAL HYB LOSS and adjust oscillator for a 0 dBm reading on measuring set at required frequency.

b. Set the FUNCTION switch to HYB CHECK and read the balance level on the measuring set.

CIRCUIT DESCRIPTION

3.1 CIRCUIT DESCRIPTION

3.2 A simplified schematic, relating the basic functions of the set, is shown in Fig. 3-1. An overall schematic diagram of the TN 33 is shown in Fig. 3-2.

3.3 Basic Hybrid. T1 and T2 are Type TN 44 coils, connected in a conventional two-coil hybrid configuration. The LINE IMP switch S1 selects the appropriate ratio taps on the 4-wire windings so that 600 ohm is presented at the 4W IN and 4W OUT jacks for the corresponding line and network termination impedance.

C1 and C2 provide dc blocking for the input and output respectively. The LINE and NET CAPS switch S7 selects the desired series line and network circuit capacitance through combinations of C701, C702 and C601, C602 respectively. C101 and C201 are selected to provide shunt padding, when required, to achieve optimum transhybrid balance.

3.4 Setting the FUNCTION switch S3 to MEASURE connects the NETWORK SELECTOR switch S4 across the hybrid network branch. Positions 1 through 16 of S4 select the various network configurations through appropriate strapping of CB3, CB4 or CB9; position 17 selects the EXT NET terminals. The networks schematics are shown in Figs. 3-3, 3-4, 3-5 and 3-6.

3.5 Two 11 position switches, S5 and S6, comprise a capacitance decade in parallel with the network selector.

3.6 With S3 set to HYB CHECK, the hybrid line and network branches are transferred to terminating resistors R1 and R2 respectively. R1 and R2 are closely matched to achieve a high degree of transhybrid balance. With S3 set to CAL HYB LOSS, the hybrid line branch is shorted and the network branch is retained.

3.7 The Filter switch S2 inserts a low pass filter located on CB5 or a high pass filter located on CB8, ahead of the hybrid 4W OUT appearances. The filter schematics are shown in Fig. 3-7.

3.8 The CIRCUIT key switch S8 transfers the hybrid 4W branch to either the A jack sets, J4, J5, and J17, J18 or the B jack sets, J6, J7 and J19, J20.

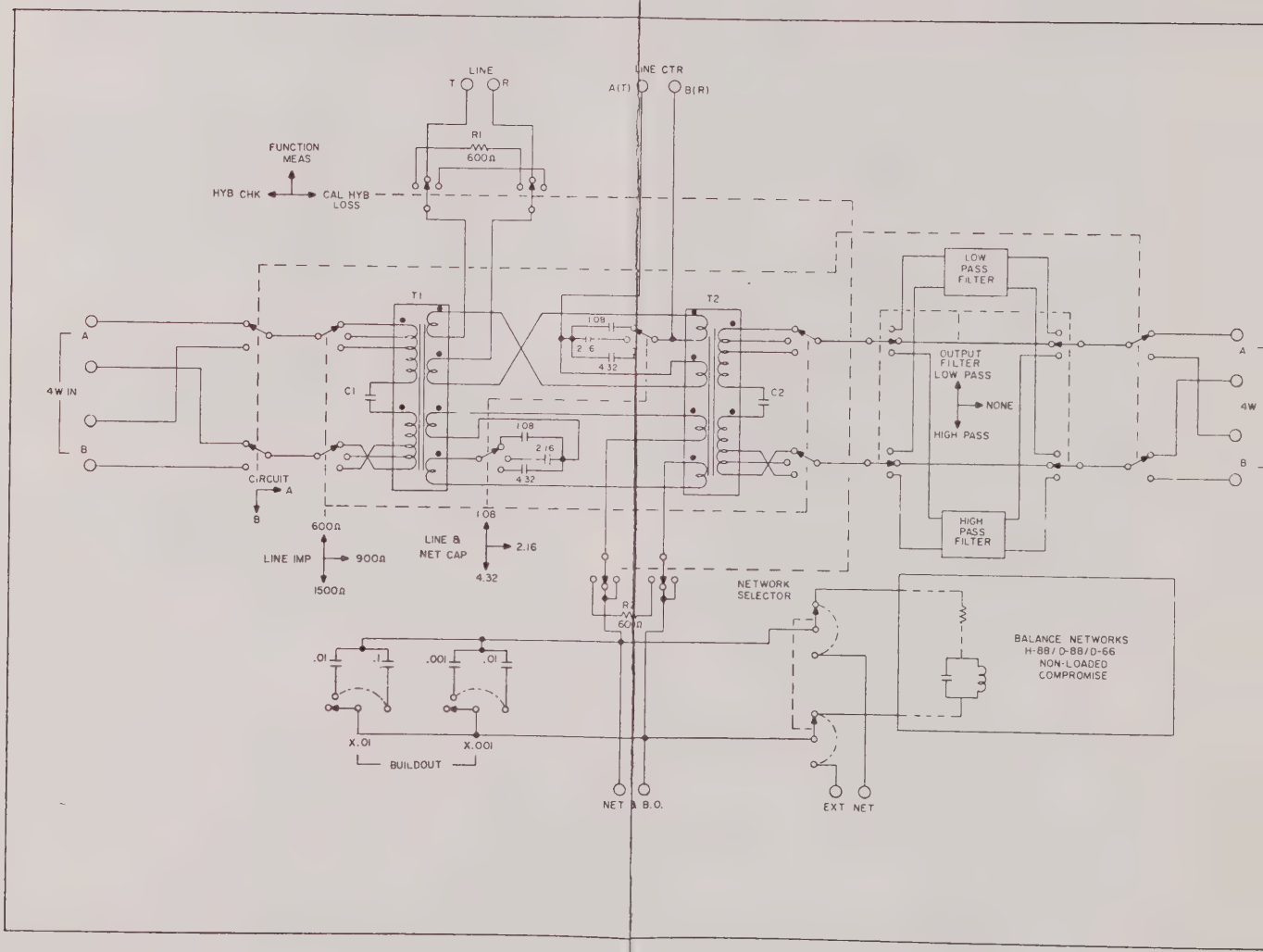


Fig. 3-1 Simplified Schematic - TN 33

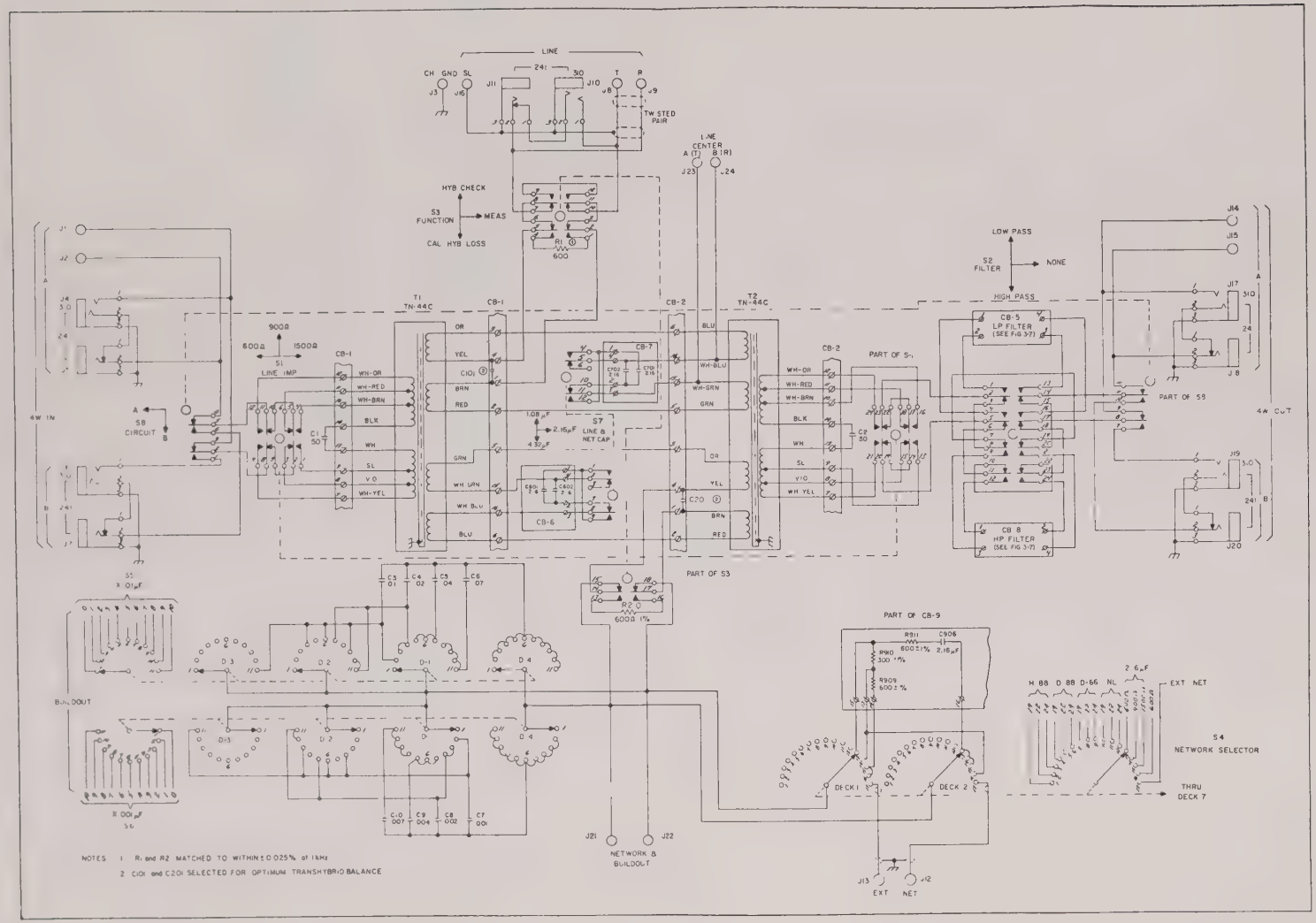


Fig. 3-2 Schematic diagram - TN 33

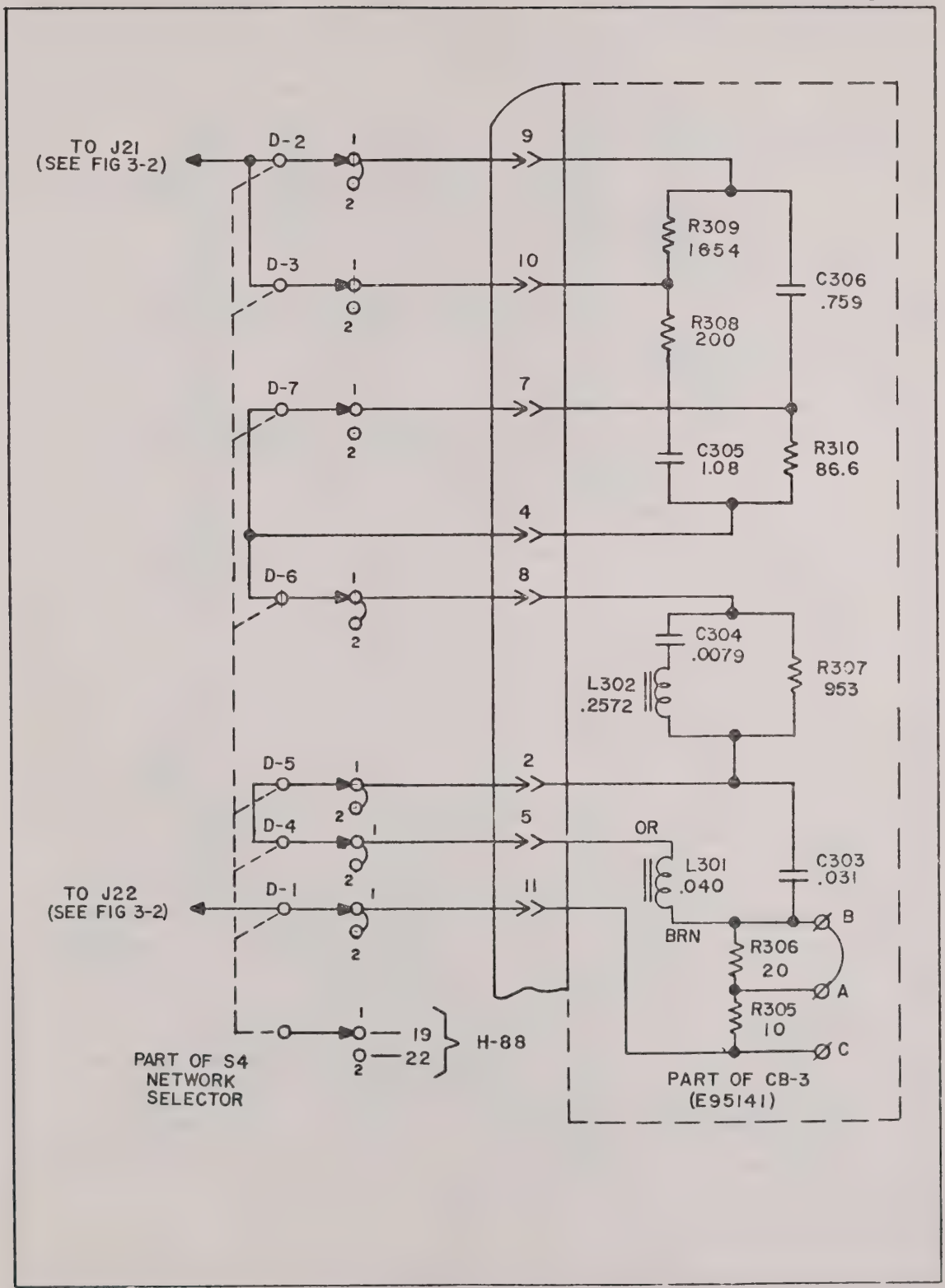


Fig. 3-3 19, 22 H-88 Network and Switching

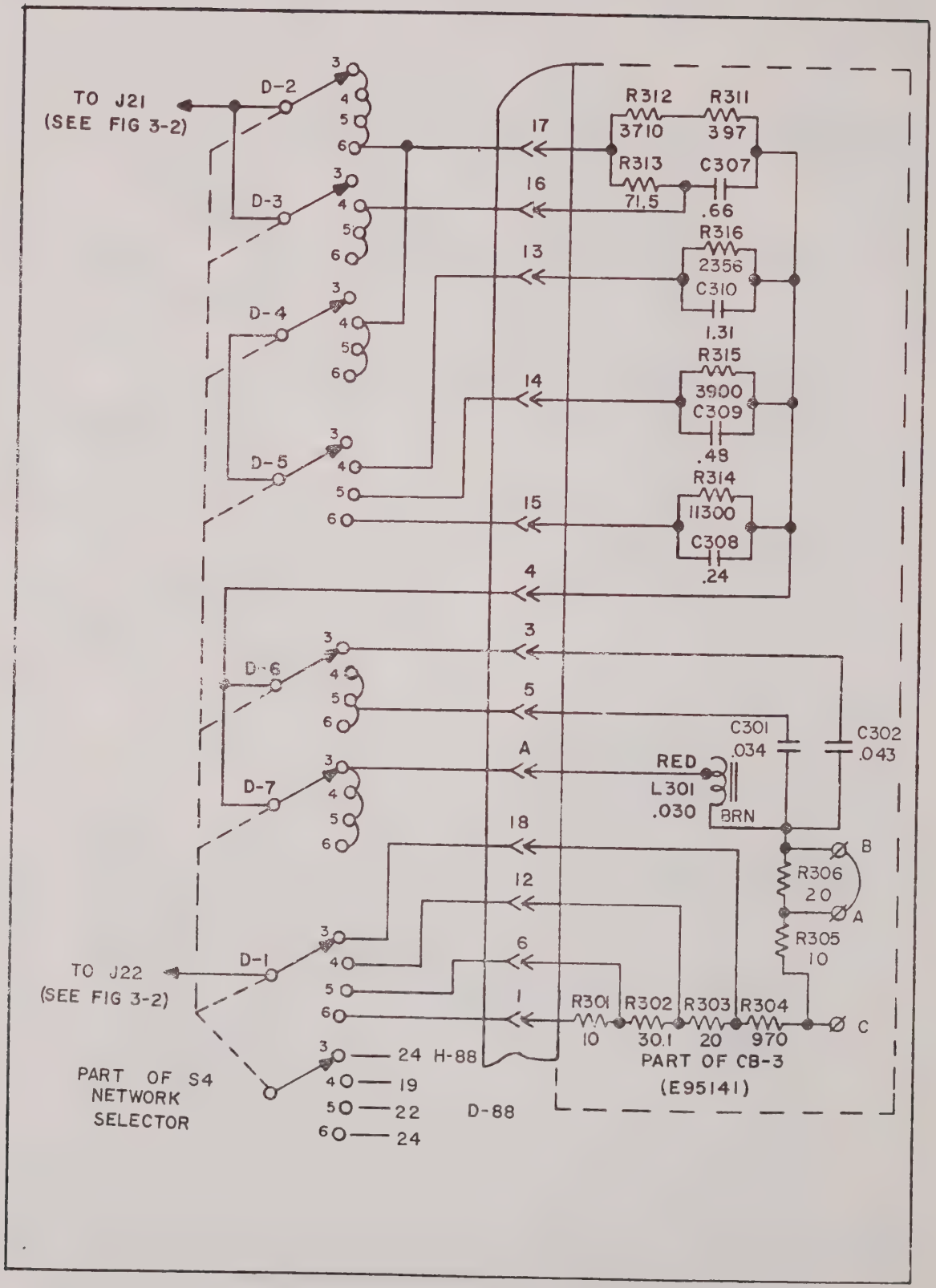


Fig. 3-4 24H-88, D-88 Network & Switching

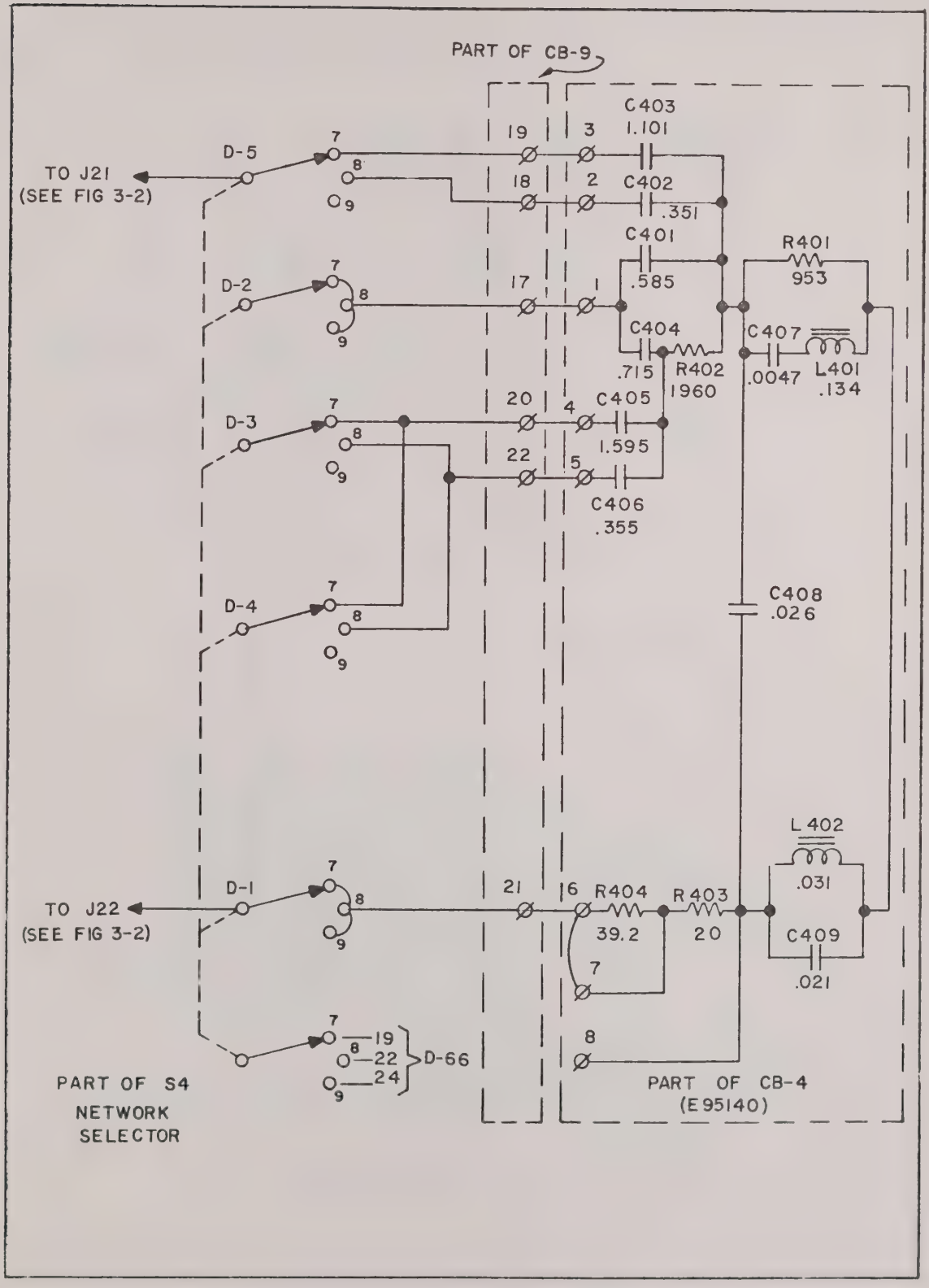


Fig. 3-5 D-66 Network & Switching

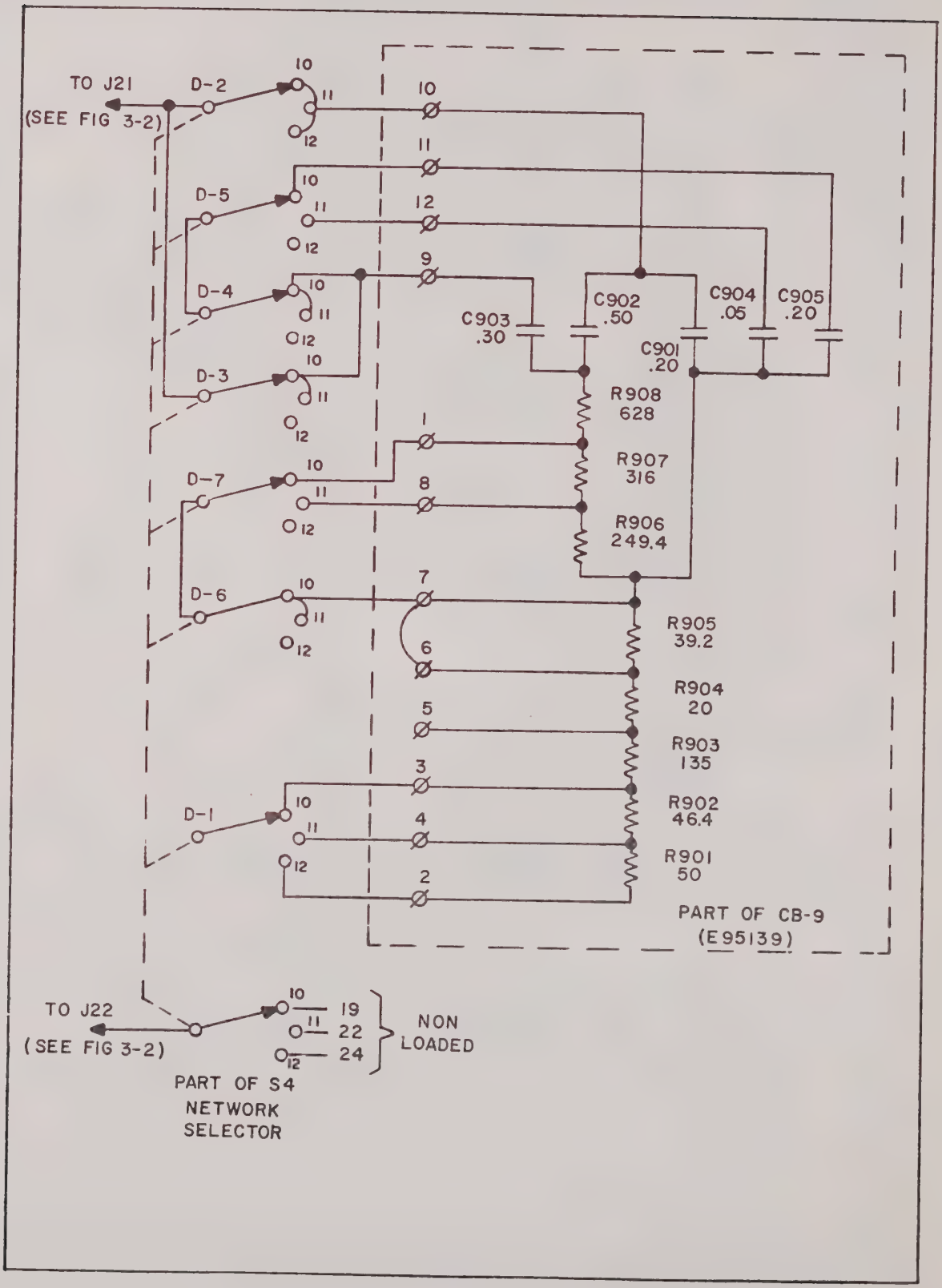
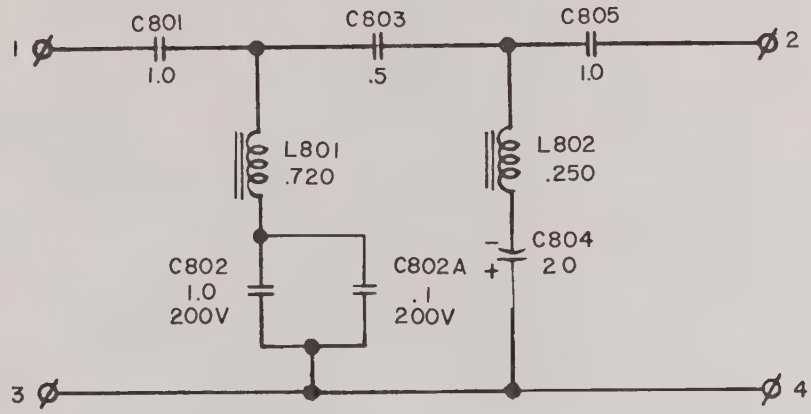
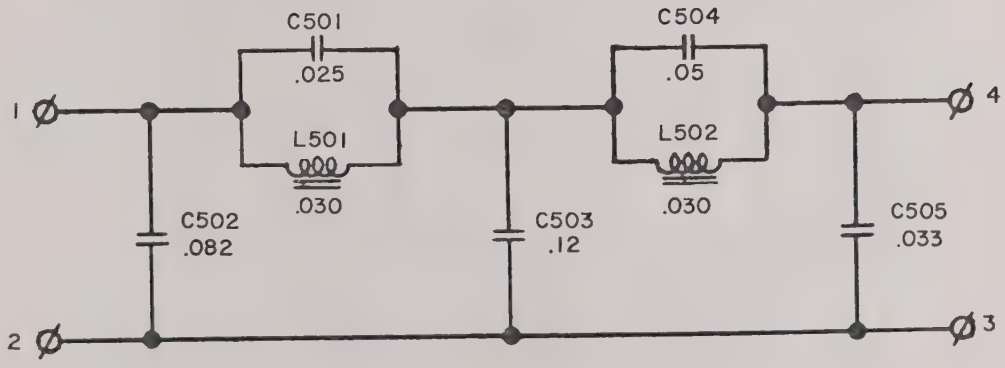


Fig. 3-6 Non-Loaded Network and Switching



HIGH PASS FILTER CB-8



LOW PASS FILTER CB-5

Figure 3-7 TN 33 Filter Schematics.

SECTION 4

MAINTENANCE INSTRUCTIONS

4.1 MAINTENANCE

4.2 The Model TN 33 contains no active elements and as such is relatively maintenance free.

4.3 If the Model TN 33 shows evidence of being erratic or becomes completely inoperable, remove the case and proceed as follows:

a. Inspect all switches and jacks for noticeable wear or misalignment of the contacts.

b. Thoroughly clean all switch and jack contacts with an approved contact cleaner. Best results are obtained when switches are moved through all positions and jacks are engaged several times while applying the cleaner.

c. If proper operation is not restored by the above, use a VOM to check the suspected circuit wiring for continuity and shorts.

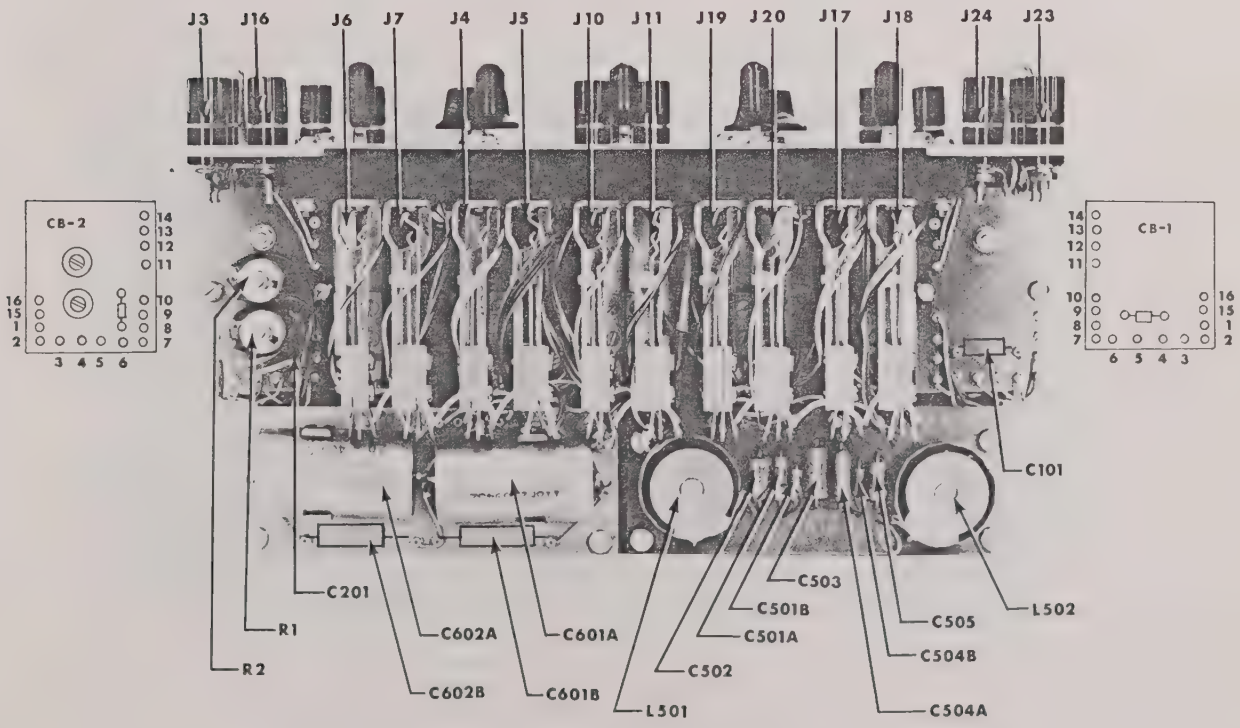
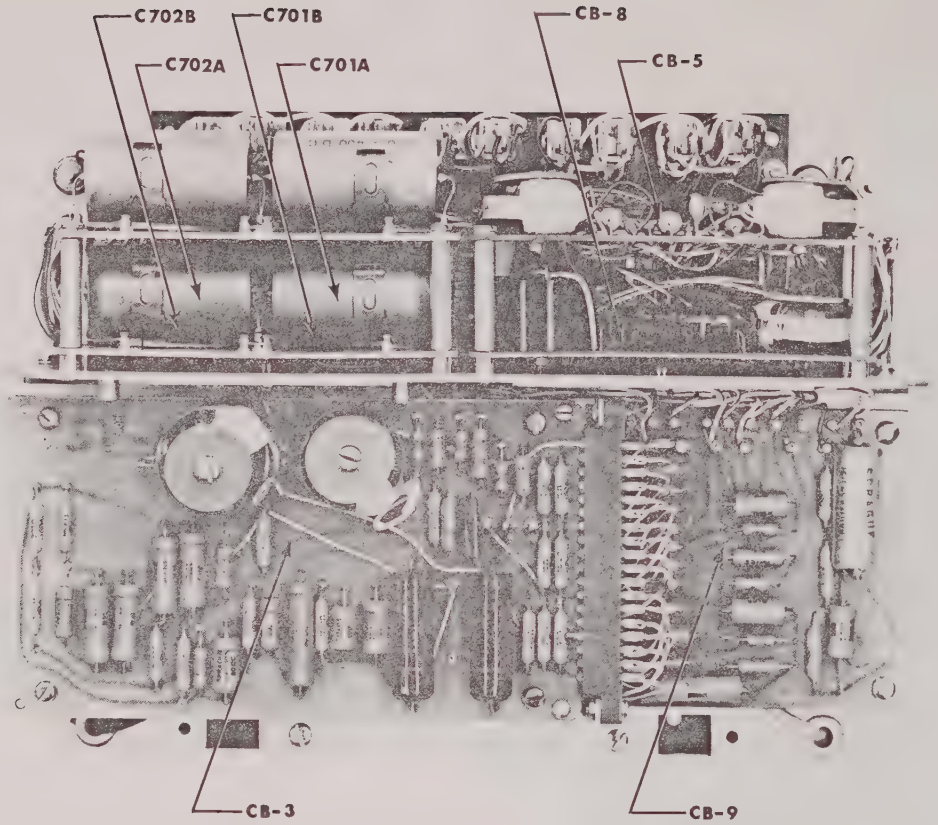


Fig. 4-1 TN 33 Top View

Section 4
Fig. 4-2



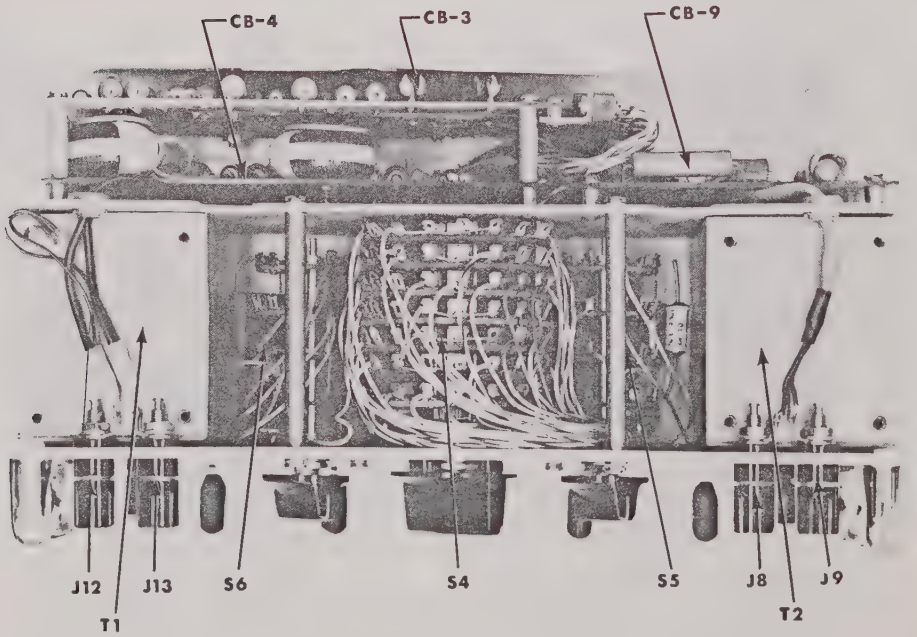


Fig. 4-2 TN 33 Rear and Bottom Views

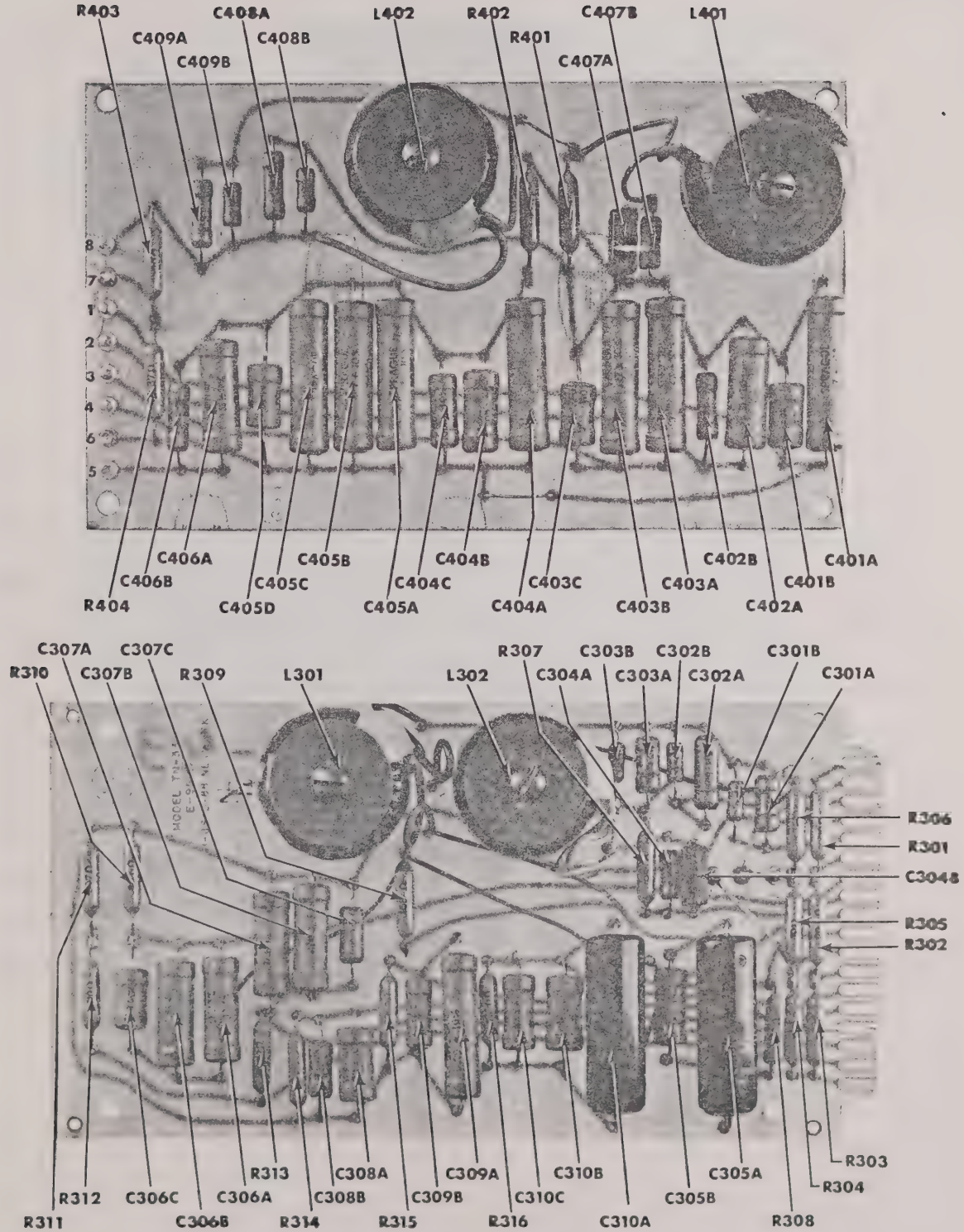
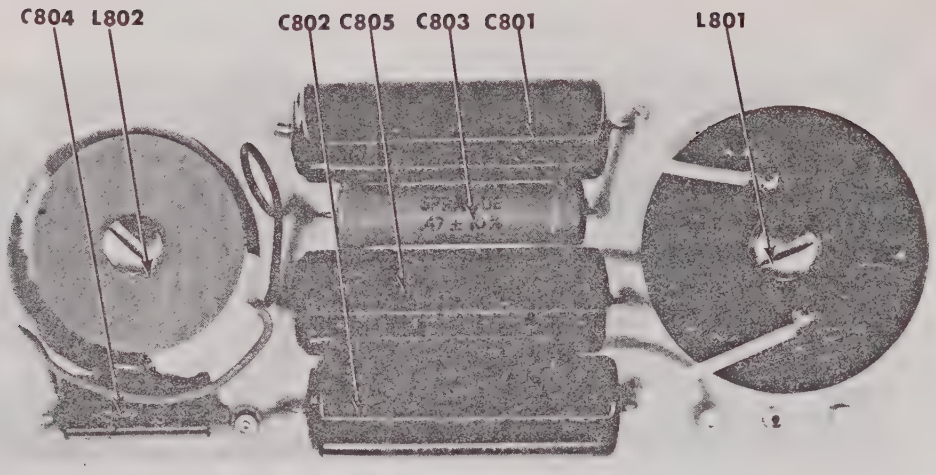


Fig. 4-3 Component Location CB-3 and CB-4

Section 4
Fig. 4-4



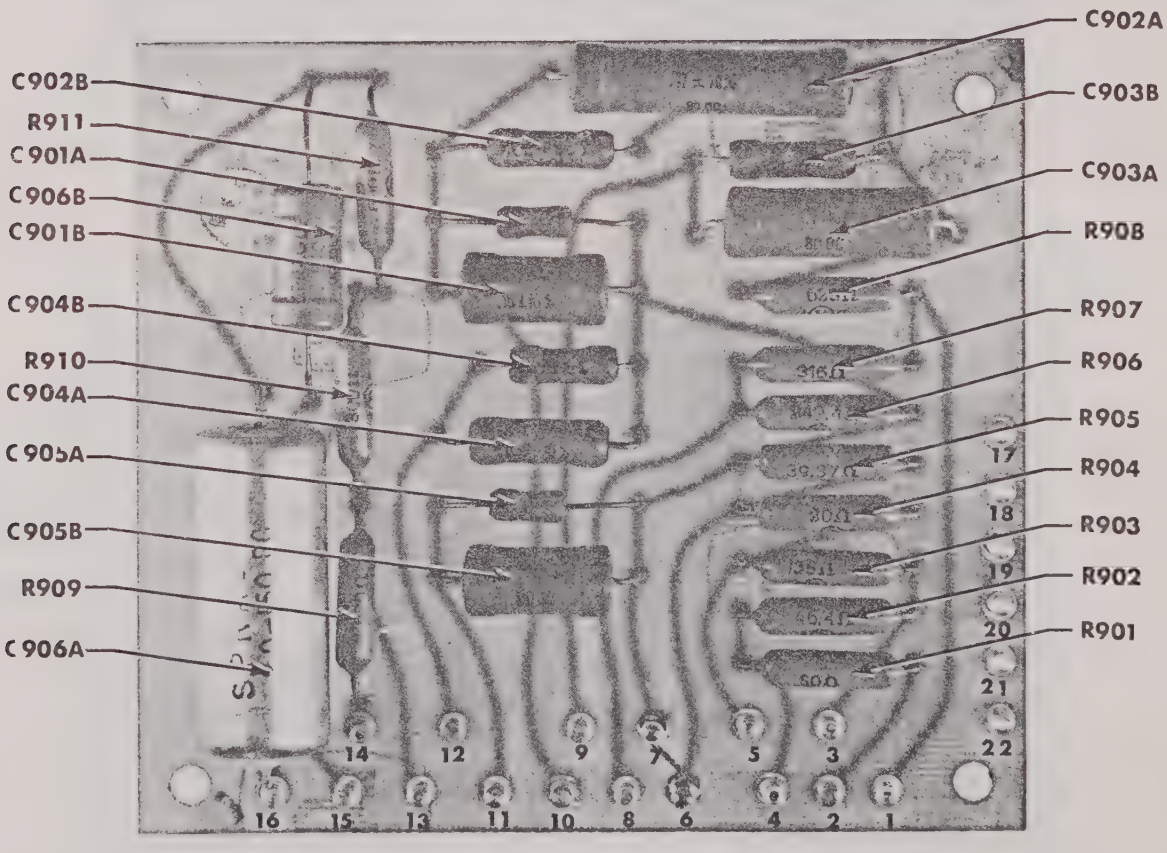


Fig. 4-4 Component Location CB-8 and CB-9

SECTION 5

ELECTRONIC PARTS LIST

5.1 The following pages contain the parts list for the TN 33 - Test Hybrid.

5.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of codes and their respective manufacturers is given on page 5-7.

5.3 Refer to Section 4, Figures 4-1 to 4-4 for the location of the component parts of the TN 33.

5.4 Abbreviations used in the Parts List:

C - capacitor
R - resistor
S - switch
Ind - inductor
Pot - potentiometer
fxd - fixed
non-pol - non-polarized
ww - wirewound
blk - black
sel val - selected value
met film - metal film
elect - electrolytic
nom - nominal value

TN 33 - MAIN ASSEMBLY

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
C 1	C: fxd non-pol 50μF 75 Vdc	13606	D27359
C 2	C: fxd non-pol 50μF 75 Vdc	13606	D27359
C 3	C: fxd plastic .01μF ±1% 200 Vdc	84171	2DJ-103F
C 4	C: fxd plastic .02μF ±1% 200 Vdc	84171	2DJ-203F
C 5	C: fxd plastic .04μF ±1% 200 Vdc	84171	2DJ-403F
C 6	C: fxd plastic .07μF ±1% 200 Vdc	84171	2DJ-703F
C 7	C: fxd mica .001μF ±1% 500 Vdc	00656	1469-102
C 8	C: fxd mica .002μF ±1% 500 Vdc	00656	1469-202
C 9	C: fxd mica .004μF ±1% 500 Vdc	00656	1469-402
C10	C: fxd mica .007μF ±1% 500 Vdc	00656	1469-702
R 1	R: fxd ww 600Ω ±1% ½W	94322	CR-35
R 2	R: fxd ww 600Ω ±1% ½W	94322	CR-35
T 1	Transformer: hybrid	06819	TN44C
T 2	Transformer: hybrid	06819	TN44C
S 1	S: key telephone 3 pos (LINE IMP)	78957	173P
S 2	S: key telephone 3 pos (FILTER)	78957	173P
S 3	S: key telephone 3 pos (FUNCTION)	78957	173P
S 4	S: rotary 17 pos 7 pole (NET SEL)	76854	253-736-DL7
S 5	S: rotary 11 pos 4 pole (BUILDOUT X.01μF)	71590	PA-1015
S 6	S: rotary 11 pos 4 pole (BUILDOUT X.001μF)	71590	PA-1015
S 7	S: key telephone 3 pos (LINE & NET CAP)	78957	173P
S 8	S: key telephone 2 pos (CIRCUIT)	78957	170E
J 1	Binding Post: black (4W IN A)	81073	29-1B
J 2	Binding Post: black (4W IN A)	81073	29-1B
J 3	Binding Post: black CH GND)	81073	29-1B
J 4	Jack: telephone (4W IN A)	82389	MT332B
J 5	Jack: telephone (4W IN A)	82389	MT332B
J 6	Jack: tel (4W IN B)	82389	MT332B
J 7	Jack: tel (4W IN B	82389	MT332A
J 8	Binding Post: black (LINE T)	81073	29-1B
J 9	Binding Post: black (LINE R)	81073	29-1B
J10	Jack: tel (LINE)	82389	MT332B
J11	Jack: tel	82389	MT332A
J12	Binding Post: black (EXT NET)	81073	29-1B
J13	Binding Post: black (EXT NET)	81073	29-1B
J14	Binding Post: black (4W OUT A)	81073	29-1B
J15	Binding Post: black (4W OUT A)	81073	29-1B
J16	Binding Post: black (LINE SL)	81073	29-1B
J17	Jack: telephone (4W OUT A)	82389	MT332B
J18	Jack: telephone (4W OUT A)	82389	MT332A
J19	Jack: telephone (4W OUT B)	82389	MT332B
J20	Jack: telephone (4W OUT B)	82389	MT332A
J21	Binding Post: black (NETWORK & BUILDOUT)	81073	29-1B
J22	Binding Post: black (NETWORK & BUILDOUT)	81073	29-1B

TN 33 - MAIN ASSEMBLY -(cont.)

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
J23	Binding Post: black (LINE CENTER A)	81073	29-1B
J24	Binding Post: black (LINE CENTER B)	81073	29-1B
	Knob for S4	80813	265
	Knobs for S5 & S6 (2 per set)	83330	2250
	CIRCUIT BOARD NO 1		
C101	C: fxd mica sel val		
	CIRCUIT BOARD NO 2		
C201	C: fxd mica sel val		
	CIRCUIT BOARD NO 3		
C301A	C: fxd film .027μF 80 Vdc	13606	192P2739R8
C301B	C: fxd film .007μF (nom) 80 Vdc	13606	192P
C302A	C: fxd film .039μF 80 Vdc	13606	192P3939R8
C302B	C: fxd film .004μF (nom) 80 Vdc	13606	192P
C303A	C: fxd film .027μF 80 Vdc	13606	192P2739R8
C303B	C: fxd film .004μF (nom) 80 Vdc	13606	192P
C304A	C: fxd film .0068μF 80 Vdc	13606	192P6829R8
C304B	C: fxd film or mica .0011μF (nom) 80 Vdc		
C305A	C: fxd met paper 1.0μF 200 Vdc	13606	155P10502
C305B	C: fxd film .08μF (nom) 80 Vdc	13606	192P
C306A	C: fxd film .33μF 80 Vdc	13606	192P3349R8
C306B	C: fxd film .33μF 80 Vdc	13606	192P3349R8
C306C	C: fxd film .099μF (nom) 80 Vdc	13606	192P
C307A	C: fxd film .33μF 80 Vdc	13606	192P3349R8
C307B	C: fxd film .27μF 80 Vdc	13606	192P2749R8
C307C	C: fxd film .06μF (nom) 80 Vdc	13606	192P
C308A	C: fxd film .22μF 80 Vdc	13606	192P2249R8
C308B	C: fxd film .02μF (nom) 80 Vdc	13606	192P
C309A	C: fxd film .39μF 80 Vdc	13606	192P3949R8
C309B	C: fxd film .09μF (nom) 80 Vdc	13606	192P
C310A	C: fxd met paper 1.0μF 200 Vdc	13606	155P10502
C310B	C: fxd film .22μF 80 Vdc	13606	192P2249R8
C310C	C: fxd film .09μF (nom) 80 Vdc	13606	192P
R301	R: fxd met film 10.0Ω ±1% ½W	07716	CECTO
R302	R: fxd met film 30.1Ω ±1% ½W	07716	CECTO
R303	R: fxd met film 20.0Ω ±1% ½W	07716	CECTO
R304	R: fxd met film 970Ω ±1% ½W	07716	CECTO
R305	R: fxd met film 10Ω ±1% ½W	07716	CECTO
R306	R: fxd met film 20Ω ±1% ½W	07716	CECTO
R307	R: fxd met film 953Ω ±1% ½W	07716	CECTO
R308	R: fxd met film 200Ω ±1% ½W	07716	CECTO

CIRCUIT BOARD NO 3 (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
R309	R: fxd met film 1654Ω ±1% ½W	07716	CECTO
R310	R: fxd met film 86.6Ω ±1% ½W	07716	CECTO
R311	R: fxd met film 397Ω ±1% ½W	07716	CECTO
R312	R: fxd met film 3710Ω ±1% ½W	07716	CECTO
R313	R: fxd met film 71.5Ω ±1% ½W	07716	CECTO
R314	R: fxd met film 11,300Ω ±1% ½W	07716	CECTO
R315	R: fxd met film 3900Ω ±1% ½W	07716	CECTO
R316	R: fxd met film 2370Ω ±1% ½W	07716	CECTO
L301	Ind: torodial, 30.0/40.0 mh ±1%	06819	030-040-4
L302	Ind: torodial, 257.2 mh ±1%	06819	2572-81

CIRCUIT BOARD NO 4

C401A	C: fxd film .47μF 80 Vdc	13606	192P4749R8
C401B	C: fxd film .115μF (nom) 80 Vdc	13606	192P
C402A	C: fxd film .27μF 80 Vdc	13606	192P3349R8
C402B	C: fxd film .081μF (nom) 80 Vdc	13606	192P
C403A	C: fxd film .47μF 80 Vdc	13606	192P4749R8
C403B	C: fxd film .47μF 80 Vdc	13606	192P4749R8
C403C	C: fxd film .16μF (nom) 80 Vdc	13606	192P
C404A	C: fxd film .47μF 80 Vdc	13606	192P4749R8
C404B	C: fxd film .18μF 80 Vdc	13606	192P1849R8
C404C	C: fxd film .065μF (nom) 80 Vdc	13606	192P
C405A	C: fxd film .47μF 80 Vdc	13606	192P4749R8
C405B	C: fxd film .47μF 80 Vdc	13606	192P4749R8
C405C	C: fxd film .47μF 80 Vdc	13606	192P4749R8
C405D	C: fxd film .185μF (nom) 80 Vdc	13606	192P
C406A	C: fxd film .27μF 80 Vdc	13606	192P3349R8
C406B	C: fxd film .085μF (nom) 80 Vdc	13606	192P
C407A	C: fxd film .0068μF 80 Vdc	13606	192P6829R8
C407B	C: fxd film or mica .0007μF (nom) 80 Vdc		
C408A	C: fxd film .022μF 80 Vdc	13606	192P2239R8
C408B	C: fxd film .004μF (nom) 80 Vdc	13606	192P
C409A	C: fxd film .018μF 80 Vdc	13606	192P1839R8
C409B	C: fxd film .003μF (nom) 80 Vdc	13606	192P
R401	R: fxd met film 953Ω ±1% ½W	07716	CECTO
R402	R: fxd met film 1960Ω ±1% ½W	07716	CECTO
R403	R: fxd met film 20.0Ω ±1% ½W	07716	CECTO
R404	R: fxd met film 39.2Ω ±1% ½W	07716	CECTO
L401	Ind: torodial 143 mh ±1%	06819	134-10
L402	Ind: torodial 31.0 mh ±1%	06819	031-5

CIRCUIT BOARD NO 5

C501A	C: fxd film .022μF 80 Vdc	13606	192P8239R8
C501B	C: fxd film .003μF 80 Vdc (nom)	13606	192P
C502	C: fxd film .082μF 80 Vdc	13606	192P8239R8
C503	C: fxd film .12μF 80 Vdc	13606	192P1249R8

CIRCUIT BOARD NO 5 (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
C504A	C: fxd film .047μF 80 Vdc	13606	192P4739R8
C504B	C: fxd film .003μF 80 Vdc (nom)	13606	192P
C505	C: fxd film .033μF 80 Vdc	13606	192P3339R8
L501	Ind: torodial ±1% 30.0 mh	81095	EC-030
L502	Ind: torodial ±1% 30.0 mh	81095	EC-030

CIRCUIT BOARD NO 6

C601A	C: fxd met paper 2μF 400 Vdc	13606	118P20594S2
C601A	C: fxd met paper 2μF 400 Vdc (alternate)	97419	M2W/Style F
C601B	C: fxd paper .16μF (nom) 400 Vdc	13606	220P
C602A	C: fxd met paper 2μF 400 Vdc	13606	118P20594S2
C602A	C: fxd paper met 2μF 400 Vdc (alternate)	97419	M2W/Style F
C602B	C: fxd paper .16μF (nom) 400 Vdc	13606	220P

CIRCUIT BOARD NO 7

C701A	C: fxd met paper 2μF 400 Vdc	13606	118P20594S2
C701A	C: fxd met paper 2μF 400 Vdc (alternate)	97419	M2W/Style F
C701B	C: fxd paper .16μF (nom) 400 Vdc	13606	220P
C702A	C: fxd paper met 2μF 400 Vdc	13606	118P20594S2
C702A	C: fxd paper met 2μF 400 Vdc (alternate)	97419	M2W/Style F
C702B	C: fxd paper .16μF (nom) 400 Vdc	13606	220P

CIRCUIT BOARD NO 8

C801	C: fxd met paper 1.0μF 200 Vdc	13606	155P
C802A	C: fxd met paper 1.0μF 200 Vdc	13606	155P
C802B	C: fxd film .1μF 80 Vdc	13606	192P1049R8
C803	C: fxd film .5μF 80 Vdc	13606	192P5049R8
C804	C: fxd elect 20μF 25 Vdc	02567	APD046
C805	C: fxd met paper 1.0μF 200 Vdc	13606	155P
L801	Ind: torodial 720 mh ±1%	53021	ET-403-1470-7
L802	Ind: torodial 250 mh ±1%	81095	EC-250

CIRCUIT BOARD NO 9

Ref Desig.	Description	Manufacturer (FSCM Code No)	Part Number
C901A	C: fxd film .18μF 80 Vdc	13606	192P1849R8
C901B	C: fxd film .02μF (nom) 80 Vdc	13606	192P
C902A	C: fxd film .47μF 80 Vdc	13606	192P4749R8
C902B	C: fxd film .03μF (nom) 80 Vdc	13606	192P
C903A	C: fxd film .27μF 80 Vdc	13606	192P2749R8
C903B	C: fxd film .03μF (nom) 80 Vdc	13606	192P
C904A	C: fxd film .039μF 80 Vdc	13606	192P3939R8
C904B	C: fxd film .011μF (nom) 80 Vdc	13606	192P
C905A	C: fxd film .18μF 80 Vdc	13606	192P1849R8
C905B	C: fxd film .02μF (nom) 80 Vdc	13606	192P
C906A	C: fxd paper 2.0μF 150 Vdc	13606	121P20591R5S4
C906B	C: fxd film .16μF (nom) 80 Vdc	13606	192P
R901	R: fxd met film 50.0Ω ±1% $\frac{1}{2}$W	07716	CECTO
R902	R: fxd met film 46.4Ω ±1% $\frac{1}{2}$W	07716	CECTO
R903	R: fxd met film 135Ω ±1% $\frac{1}{2}$W	07716	CECTO
R904	R: fxd met film 20.0Ω ±1% $\frac{1}{2}$W	07716	CECTO
R905	R: fxd met film 39.2Ω ±1% $\frac{1}{2}$W	07716	CECTO
R906	R: fxd met film 249.9Ω ±1% $\frac{1}{2}$W	07716	CECTO
R907	R: fxd met film 316Ω ±1% $\frac{1}{2}$W	07716	CECTO
R908	R: fxd met film 628Ω ±1% $\frac{1}{2}$W	07716	CECTO
R909	R: fxd met film 600Ω ±1% $\frac{1}{2}$W	07716	CECTO
R910	R: fxd met film 300Ω ±1% $\frac{1}{2}$W	07716	CECTO
R911	R: fxd met film 600Ω ±1% $\frac{1}{2}$W	07716	CECTO

LIST OF MANUFACTURERS

Code No	Manufacturer
00656	Aerovox Corporation
02567	International Electronics Industries
06819	Northeast Electronics Corporation
07716	International Resistance Company
13606	Sprague Electric Company
53021	Sangamo Electric Company
71590	Centralab
76454	Oak Manufacturing Company
78957	Stromberg-Carlson Company
80813	Dimco Gray
81073	Grayhill
81095	Triad Transformer Company
82389	Switchcraft Incorporated
83330	H.H. Smith Company
84171	Arco Electronics Incorporated
94322	Tel Labs Incorporated

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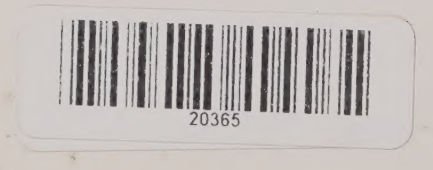

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